tion sensitive detector in the same manner as shown in FIG. 11 to direct the point of convergence to a different position.

FIG. 13 shows an alternate embodiment that uses a single concave mirror 120 to redirect the point of convergence shown in FIGS. 11–12 to a more convenient position. In this case the single concave mirror 120 replaces the flat mirror 103 shown in FIG. 11 and the relay lens 110 shown in FIG. 12.

A method of operating the AFM according to present invention will now be described. As shown in FIG. 4A, for example, a light beam is generated and then directed onto cantilever 14 using optical assembly 43 so that the light beam strikes substantially a fixed point on cantilever 14, during movement of the scanning mechanism. The striking of substantially a fixed point is illustrated in FIG. 13, where light beams 101 strike cantilever 14 while it is scanned across sample 13. The light beam reflected from cantilever 14 (47 in FIG. 4) is received by position detector 16 which can detect deflections of cantilever 14.

Also illustrated in FIG. 4A is the splitting of beam 44 using splitter 45 and the cut out in mounting member 42 (FIG. 4B) to allow access of an optical microscope 46, while in FIG. 7 the beam 68 is split using splitter 65 to direct a portion of the the beam 68 to a second position detector 66.

FIG. 14 is a flowchart of a modification of the method of the invention where the location of the position detector is determined. First, in step 14-1, the light beam reflected from the cantilever is measured while the scanner 12 is scanned over a full extent of its movement on a very flat surface or while actually not touching any sample. The change in position in the measured signal is then determined using position sensitive detector 16 (step 14-2). The amount of change in this signal is a measure of the amount of "false deflection" being seen by the system. The position sensitive detector is then moved closer or further from the cantilever (along the optical axis of the reflected beam) and the scanning process repeated (step 14-3) a desired number of times until these "false deflections" are minimized (step 14-4). Position detector 16 is then placed at this location of minimum change (step 14-5).

While the invention has been described with reference to several specific embodiments, those skilled in the art will be able to make various modifications to the described embodiments without departing from the true spirit and scope of the invention. For example, an AFM that scans using other optical elements such as prisms instead of lenses or mirrors, or other combinations of such elements to keep the laser focused on a scanning cantilever, is within the intended scope of the invention. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced other than as specifically described herein.

Although what has been described is a contact AFM, where the stylus is in constant contact with the surface, the described invention can also be used in applications where the cantilever is oscillated, such as magnetic force microscopy (Martin and Wickeramasingle, Appl. Phys. Lett., 50, pg. 1455 (1987), Non-contact Topography, Durig et al, Phys. Rev. Lett., 53, p. 1045, (1988)) and as a jumping probe microscope where the stylus is repeatedly lifted off the surface during a scan (U.S. patent application Ser. No. 08/009,076), now U.S. Pat. No. 5,266,801.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. An atomic force microscope, comprising:

a scanning mechanism;

an optical lever system including,

a light source not moved by said scanning mechanism,

a cantilever moved by said scanning mechanism so that said cantilever may be scanned over a sample, and

a position detector not moved by said scanning mechanism which receives reflected light from said cantilever and detects an angular deflection of a free end of said cantilever;

an optical assembly including at least one steering lens to guide light emitted from said light source onto the cantilever to follow substantially a fixed position on said cantilever during movement of said scanning mechanism; and

a fluid cell translated by said scanning mechanism.

2. An atomic force microscope as recited in claim 1, wherein at least one surface of said fluid cell is substantially parallel to said cantilever.

3. An atomic force microscope as recited in claim 1, further comprising:

a body of fluid disposed onto at least a portion of said sample, and

said fluid cell having an optically transparent region which comprises upper and lower surfaces,

wherein said fluid is adjacent said lower surface of said transparent region and further wherein said light beam from said light source strikes said upper surface and passes through said fluid cell and is incident on said cantilever.

4. An atomic force microscope as recited in claim 3, wherein at least one of said upper and lower surfaces of said fluid cell is substantially parallel to said cantilever.

5. An atomic force microscope comprising:

a scanning mechanism; and

an optical lever system including,

a light source not moved by said scanning mechanism,

an optically transparent fluid cell included on said scanning mechanism so that said cell may be translated by said scanning mechanism,

a cantilever mechanically coupled to said fluid cell and said scanning mechanism so that said cantilever may be scanned over a sample, and

a position detector not moved by said scanning mechanism and which receives reflected light from said cantilever and detects an angular deflection of a free end of said cantilever;

said atomic force microscope further comprising an optical assembly including at least one steering lens to guide light emitted from said light source onto the cantilever to follow substantially a fixed position on said cantilever during movement of said scanning mechanism.

6. An atomic force microscope as recited in claim 5, wherein said optical assembly comprises means for producing a point source of light between a fixed end and said free end of said scanning mechanism.

7. An atomic force microscope as recited in claim 5, wherein a stylus is included substantially on the free end of said cantilever.

8. An atomic force microscope as recited in claim 5, wherein at least one surface of said cantilever mount is substantially parallel to said cantilever.

9. An atomic force microscope as recited in claim 5, wherein said optical assembly guides said light onto substantially a fixed position on said cantilever during a scan of said scanner of at least 30 μm.

10. An atomic force microscope as recited in claim 5, wherein said scanning mechanism comprises a piezoelectric tube and said optical assembly is mounted in said tube.